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the spermatozoid, however, may continue for ten or fifteen minutes, and of the cilia for five minutes longer. PFEFFER'S capillary method was used in the experiments. The principal headings are: position chemotaxis, relation between the intensity of the stimulus and extent of the reaction, repulsion by free acids and alkalis, negative chemotaxis with the ions of heavy metals, repulsive effect of alkali salts, behavior with osmotically acting substances, repulsive effect of ions of certain organic acids, the action of narcotics, theoretical, and review.

Malic acid acts as a strong topochemotactic stimulus and may be regarded as the specific stimulant for the spermatozooids of *Isoetes*, although certain other substances also exert some topochemotactic influence. Free malic acid in weak solutions exerts a positive chemotactic influence, but in stronger solutions a negative one. The salts of various metals act as negatively chemotactic stimuli, as do also the anions of di- and tribasic organic acids, including malic acid. The positive chemotaxis with malic acid is of a typically topotactic nature. The reaction consists in a turning of the body axis of the spermatozoid and a movement toward the source of stimulation. Whether the structure for the perception of chemotactic stimuli consists of the whole body of the spermatozoid or only of localized portions of it is not yet determined.—C. J. CHAMBERLAIN.

Tuberization.—The causes of tuberization still furnish a field for study. BERNARD first supposed that *Fusarium Solani* was the endophytic fungus of the potato; this has since been disproved by GALLAUD and by BERNARD himself, but the identity of the fungus is still undetermined. H. JUMELLE⁹ has been conducting experiments on *Solanum Commersoni*, a tuber-bearing species related to the potato, but as yet his results are largely negative. The chief interest attached to his studies are occasioned by the fact that *S. Commersoni* has small slowly developing tubers placed on long stolons; these are the very characters which the potato is said to have had when first introduced into Europe, before the endophytic fungus became sufficiently abundant. *S. Commersoni* was infected by fungi from *S. tuberosum*, but, as stated above, with negative results. JUMELLE thinks that with suitable infection, it may be possible to secure tubers like those of the potato, and further experiments are in progress. It should be said that GALLAUD thinks that BERNARD has not yet isolated the true tuber-forming fungus.—H. C. COWLES.

Two parasitic fungi.—KLEBAHN¹⁰ has worked out the life histories of two common species of the so-called Imperfecti group. The first of these is the common elm fungus, *Phleospora Ulmi* (Fr.) Wallr. This is connected with an ascomycetous form, which appears on the infected dead leaves during the winter and ripens in spring, when the spores are ejected and infect the young

⁹ JUMELLE, H., De l'influence des endophytes sur la tubérisation des *Solanum*. Rev. Gén. Bot. 17:49-59. 1905.

¹⁰ KLEBAHN, H., Untersuchungen über einige *Fungi imperfecti* und die zugehörigen Ascomycetenformen. I. u. II. Jahrb. Wiss. Bot. 41:485-560. figs. 75. 1905.

elm leaves. The form is named *Mycosphaerella Ulmi* Klebahn¹¹. Both conidia and ascospores produced identical mycelia in cultures. The Phleospora was produced by sowing ascospores on the under side of elm leaves. No infection took place from spores sown on the upper surface. The study of *Gloeosporium nervisequum* (Fckl.) Sacc. revealed a rather complicated series of forms belonging to this fungus. An ascogenous stage develops on the dead leaves, as in Phleospora. This is *Gnomonia Veneta* Klebahn. Beside the usual conidial form and the ascogenous form, the fungus assumes the form of a Myxosporium on the young branches, and there produces the twig wilt always noticed on sycamore trees affected with the Gloeosporium. A fourth form develops on the dead leaves. This is a conidial form of the Fusicoccum type. Proof of the connection of all these forms rests mainly in the similarity of the mycelia produced in pure cultures from the various spore forms. Infections could not be produced readily, but a few cases of inoculation with ascospores were successful. The various spore forms have been described under different names, which are given in the synonymy.—H. HASSELBRING.

Shore formations in Denmark.—WARMING, in collaboration with WESENBERG-LUND and others in an interesting paper, has correlated the work of plants and animals in the shore formations of western Denmark.¹² A "vad" is a shallow coastal lagoon, cut off from the sea proper by a line of islands, and bare at low tide; the bottom may be of sand or clay, the latter type prevailing in the more tranquil places. The sandworm, *Arenicola marina*, is the most characteristic animal of the sandy "vader" or shallows, and the excrements of this worm are found there in great abundance. Hence it has commonly been thought that these animals have a soil function, similar to that of the earthworm, and that they help to build up the shallow into a marsh. The authors, however, find that *Arenicola* is very sedentary in its habits, swallows only from surface layers, and that it retards rather than furthers soil enrichment. The waves wash any fine particles landward, leaving the *Arenicola* shallow as sandy as before and hence well adapted for the continued prosperity of *Arenicola*. In shallower water closer to the shore, where the bottom material is finer, the amphipod, *Corophium grossipes*, dominates; here the bottom is characteristically red-brown in color and presents a riddled surface appearance. The *Corophium* shallows teem with animal life, and here the influence of the animals is such as to convert the area somewhat rapidly into a marsh. To this work blue green algae contribute something, but animals are much more important land builders than plants in the *Corophium* shallows. Large areas of land have been gained from the sea in this way in Denmark, and one case is cited where a fertile meadow has been developed from a barren sandy shallow within two hundred years. In the argillaceous

¹¹ Preliminary note in Zeitschr. Pfl. krankh. 12:257. 1902.

¹² WARMING, E., Bidrag til Vadernes, Sandenes, og Marskens Naturhistorie. In collaboration with WESENBERG-LUND, ØSTRUP, et al., with French résumé. Kongl. Dansk. Vid. Selsk. Skrift. VII. 2:1-56. 1904.